

### Method for producing electrical energy

A process is known for generating high DC voltages by mechanical displacement of electrical charges. In doing so the charges between two working media are separated by triboelectrification or by induced electrization, one of the two media being electrically connected to an electrode.

Accordingly the second working medium is transferred to another electrode on which the charge is picked up. The described process is carried out in devices which are called electrostatic generators (DE 23 36 487 A1, European Patent Application 0229 843 A1).

A process is known for producing electrical energy by friction of certain stiff dielectric surfaces consisting of different materials against one another, and it is accomplished in a compact device (European Patent Application 0366591 A1).

The cited devices which accomplish the known processes are characterized by the possibility of generating electrical high voltage (up to 15-20 MV), by a low current (up to 10 mA), therefore also by low power. The power of these devices is limited on the one hand by the maximum allowable surface density of charges on a conveyor, the carrier of the charge, on the one hand, and by the speed of mechanical movement of this charge conveyor.

The charge density for its part is limited by the formation of an electrical discharge on the surface. The speed of the charge conveyor is limited by the mechanical motion possibilities of the system parts.

The efficiency of the system is determined mainly by the aerodynamic losses as the charge conveyor is moved mechanically and by the friction of the mechanical system parts among one another. In existing devices this is not greater than 15-20%.

The object of the invention which is given in claims 1-6 <sup>112 ?</sup> is to increase the power and the efficiency of the devices which implement the described process and to enable conversion of the thermal energy into electrical energy.

This object is achieved by the features listed in claims 1-5. <sup>?</sup>

The advantages which are achieved with the invention consist especially in that the indicated process enables use of thermal energy of any heater for its direct conversion into electrical energy, high output power and high efficiency being achieved.

As a result of the properties of the heat tubes, a relatively small temperature difference between the heater and cooler is sufficient to achieve a high flow velocity of the gaseous working medium of the heat tubes and consequently also high kinetic energy. By means of this kinetic energy the indicated flow causes triboelectrification of the working media of the electrostatic generator and mechanical separation of charges. In the devices which implement this process thus there are no mechanically moving parts, for which reason all losses of power and efficiency which occur for this reason are prevented. Moreover, in this case drive does not take place by external mechanical work, but by thermal energy which can even be removed from a small temperature difference. <sup>?</sup>

The embodiments of the process are shown in the drawings and are detailed below.

Figure 1 shows an embodiment of the process in a fixed device with its indicated orientation in the gravitational field.

Figure 2 shows an embodiment of the process in a device which can function at different orientations, in a gravitational field, and also in weightlessness.

Figure 3 shows an embodiment of the process in which the working liquid of the electrostatic generator is not electrified at the site of its detachment from the mouth of the feeder

nozzle, but at some distance from it by the breakdown of the droplets when they suddenly encounter the grid.

All types of devices which enable the process contain a heat tube (WR) 1 and a generator 2. The heat tube 1 has the working medium in the liquid phase (the working liquid of the heat tube) 3 and in the gaseous phase (the working gas of the heat tube) 4, and a capillary insert of the heat tube 5. The generator 2 contains the solid working medium of the generator 6, the liquid working medium of the generator 7, the grid for charge pick-up 8, the external electrodes 9a and 9b and the loop 10 for return of the liquid working medium.

When an external temperature gradient builds up between the vaporizer 11 and the condenser of the heat tube 12 the working liquid of the heat tube vaporizes in the vaporizer on its capillary structure. At the same time the working gas of the heat tube condenses on the capillary structure of the condenser of the heat tube. The liquid 3 travels via the capillary insert 5 out of the condenser back into the vaporizer.

It is sufficient for the continuation of the process that the latent heat of vaporization in the former case is supplied to the working medium of the heat tube and in the latter case is removed. Therefore this process can also be carried out at a very small temperature difference.

Here the volume of the working medium of the heat tube in the vaporizer increases suddenly and as a result the pressure of the working gas 4 in the vaporizer does likewise. The volume of the working medium and the pressure of the working gas of the heat tube in the condenser decrease equally suddenly.

Thus, at a small temperature difference in a closed space two processes of increase and decrease of the gas pressure take place simultaneously and uninterruptedly in a closed space; these processes are distributed in space, proceed with different signs, and are explosive according to properties. This leads to formation of a high speed gas flow from the vaporizer into the condenser.

In doing so the thermal energy which is supplied to the heat tube is converted into kinetic energy of the molecules of the gas flow and can be converted further into other types of energy, for example, into electrical energy.

The solid working medium 6 and the liquid working medium 7 of the generator 2 are accommodated within the heat tube, roughly at the location of the maximum flow of the working gas of the heat tube 4, directly behind the diaphragm 13. The diaphragm 13 concentrates the gas flow from the vaporizer into the condenser. In doing so the solid working medium 6 is attached stationary with respect to the heat tube.

The liquid working medium 7 is supplied to the interior of the heat tube via the feeder 14, charge separation and charge displacement taking place using the directed gas flow of the heat tube, which flow entrains liquid particles and routes them past the other working medium for charge separation and displacement.

Subsequently the charge is picked up on the external electrode 9a, quite analogously to the manner in which this takes place in electrostatic generators with solid media.

In one version of process execution (Figure 2) the loop 10 for return of the liquid working medium 7 of the generator is filled with the capillary structure. This makes it possible for the device to work regardless of its location in the gravitational field, and also in weightlessness. Here the open surface of the aforementioned capillary structure is housed directly behind the grid of the pick-up electrode 8.

In the embodiments of other versions of the process (Figure 3) charge separation takes place by the liquid 7 striking the medium 6. Here the medium 6 has the shape of for example a grid. In this case the solid working medium is moved at some distance l from the insertion site of the feeder 14 into the interior of the heat tube. The droplets of the medium 7 before striking the medium 6 acquire a certain kinetic energy which is expended for charge separation. After impact the charged droplets are carried on further with the gas flow of the heat tube 4 to the electrode 8.

The gases which are not condensing and which remain in the heat tube (for example air and also vapors of the working liquid of the generator which in a closed space are inevitably joined to the liquid which has a free surface) are pushed away by the working gas of the heat tube to one of the ends of the tube in the first seconds of operation of the heat tube, and form a gas cushion 15.

In the geometry of the heat tube and the electrode for the charge pick-up 8 (Figures 1-3) this gas cushion to a certain extent thermally insulates the pick-up electrode 8 and the wall of the heat tube adjoining it. Therefore the temperature of the electrode generally differs from the temperature of the capillary structure of the condenser of the heat tube.

Since the insertion site of the feeder 14 into the heat tube is outside of the vaporizer, the same liquid can be used as the working liquid of the heat tube and of the generator.